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CONTENTS

NEW SOVIET COMPUTERS DISPLAYED IN BUDAPEST

Budapest FIGYELO in Hungarian 18 Nov 82 pp 10-11

[Interview with Anatoliy Smirnov, USSR deputy minister of instrument building, by staff reporter Farago: "New Computers in the Soviet Union"]

> [Text] Within the framework of the socialist countries' co-
> ordinated minicomputer program, the series production of two
> new models has been organized in the Soviet Union. The in-
> ternational introduction of the SM 1300 and SM 1800 models
> took place recently in Budapest. At a specialized show spon-
> sored jointly by the Elektronorgtekhnika Foreign Trade Associ-
> ation and the Computer Applications Enterprise (Szamitastech-
> nika Alkalmazasi Vallalat), Hungarian computer users were not
> only able to become acquainted with the computers, but they
> could also attend lectures on the software library, methods
> of application and the technology. Anatoliy Smirnov, USSR
> deputy minister of instrument building, came to Hungary to
> attend the show. We interviewed him on some questions of the
> production and applications of Soviet computers.

[Question] For what types of application are the displayed computers recommended?

[Answer] The developers of the SM 1800 system recommend it for industrial and scientific applications, and for data processing as well. Its design is modular, and thus very many different configurations are possible for the solution of specific tasks. The SM 1800 system is compatible with computers built under the socialist countries' unified computer program, and with several other types as well. Hence it can serve as the remote terminal of a larger computer system. Thus it is possible to set up concentrated data processing systems for multi-plant enterprises and farms, within which information flows between plants lo-cated at various distances and their headquarters. The essential thing is that the information is transmitted over telephone lines, instead of being sent on paper or magnetic tape. Thus the system is not only more simple, but also more reliable. The SM 1300 may be regarded as the "little brother" of the already familiar SM 4. Its software is the same as that of the latter, it is able to perform the same functions, but its dimensions are substantially smaller. Thus it can be used also for applications for which the SM 4 is unsuitable, because of its larger space requirement. For example, the SM 1300 can be built into new equipment such as machine tools, process control systems, etc.

[Question] When will the export of these new computers begin?

[Answer] In the Soviet Union, one of the conditions for exporting industrial equipment and instruments is that they must meet the domestic specifications for their testing. The tests are already in progress, and the results are satisfactory. The R & D and industrial enterprises under the Ministry of Instrument Building estimate that exports of the SM 1800 system can begin already in the first quarter of 1983. Shipments of SM 1300 can begin not later than by the end of the year. These target dates are significantly shorter than what we set in the original program. The explanation of the shorter target dates is that very many sectors in the Soviet Union are demanding more modern minicomputers, and fortunately this demand of the economy and of the enterprises was combined with the new type of economic incentive for the developers and producers. The essence of this new type of incentive is that the bonuses of the persons concerned are the larger, the more the target dates are shortened.

[Question] How will the new computers be priced?

[Answer] Export pricing is the task of the foreign-trade enterprise. But I can say this much: even though the computers are able to do more, have modern microprocessors and are smaller than the SM 4, their production cost is lower. We believe the price, in comparison with the SM 4, can be reduced to at least one-half.

[Question] What is the explanation of the price reduction?

[Answer] During the past decade the Soviet Union gained considerable experience in the development and production of computers. This experience is now paying dividends. For example, planners and designers required less R & D time than in the past, the prototypes were built faster, and also the organization of series production required less time than what had been planned. Another cost-reducing factor is that Soviet supplier industries have been able to produce at lower cost the microprocessors, subassemblies and components for the new computers. We have been able to modernize significantly the production technology and the organization of production, as a result of which productivity has improved considerably.

[Question] Will the new computers be more reliable?

[Answer] Definitely. A basic requirement in the development of both types was that failures must be reduced to a minimum. We also introduced stricter quality control. We are inspecting all subassemblies and components, at the supplier enterprises as well as at the computer plants. Furthermore, we are devoting more time to testing the finished product, in order to uncover possible bugs. The ministry has not only formulated new guidelines for quality control, but it is also monitoring continuously the development of quality. In accordance with the reports, we resort to operational interventions when necessary. Which means that we reduce bonuses commensurately with the rise in the percentage of rejects. We are planning to perfect the economic incentive by taking into consideration also the final users' experience and comments. At the same time we are expanding our service network. There are now about 850 Soviet computers in operation in 18 countries. We are planning to increase our export by 10 to 15 percent a year. However, we are aware that to be competitive we not only have to ship on schedule, but must also ensure the servicing of the products we sell.

[Question] As you have indicated, the two computer systems just introduced are a part of a large-scale program. Where is the development of computers in the Soviet Union heading?

[Answer] In accordance with the international trends, we too are pursuing two directions. On the one hand we are working on perfecting universal computers. Which means primarily that we wish to expand the applications of a given computer. We are urging the development of computers that will make easier the management of large enterprises and the organization of production. On the other hand it is also our objective to develop small special-purpose computers whose areas of application will be limited, but which will offer substantial benefits to the economy and the enterprises in their areas of application. So far as computer power is concerned, here again we are thinking in terms of two categories: mainframes and small computers. There is less demand for intermediate computers, which is a worldwide trend, and for the time being it does not seem worthwhile to develop this type of computers.

[Question] There is much talk in professional circles about the still inadequate utilization of computers. What is being done in the Soviet Union to improve their utilization?

[Answer] A sample survey was conducted recently to determine the degree of utilization of the computers made by enterprises of the Ministry of Instrument Building. The results show that there still are many installations that are being utilized only 3 or 4 hours a day. Of course, this does not include process control computers. Therefore we are recommending that the leasing of computer time be introduced in the Soviet Union as soon as possible. But the administrative regulations and economic incentives for this must be worked out. The sample survey also serves as a guide for computer R & D and manufacturers, telling them in which direction they must proceed when developing new computers. Parallel with this we must urgently improve information for computer users. Often our user partners are still unable to formulate accurately their requirements and expectations.

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CSO: 2502/8

EYE PROTECTION AGAINST HELIUM-NEON LASER EMISSIONS ANALYZED

[Article by Milos Horky, Institute of Instrument Engineering, Czechoslovak Academy of Sciences, Brno: "Use of Interference Filters for Eye Protection Against Light From He-Ne [Helium-Neon] Lasers"]

[Text] This study indicates the possibility of using protective interference filters in eyeglasses for protection against light from continuous-wave He-Ne lasers. They have the advantages of high transmissivity outside the suppression range, even when two filters are used one behind the other. In addition, they meet the condition of suppressing spontaneous radiation from the discharge tube below a dazzling level.

Introduction

The purpose of this study was to test the suitability of using interference filters for eye protection during work with continuous-wave He-Ne lasers developed by the Institute of Instrument Engineering in Brno and produced by Metra Blansko. Since their radiation flux (power) ranges from 0.8 to 100 mW, the main danger is damage to the organs of sight, and accordingly the use of protective glasses is essential.

The general principles are fairly well known and because of the specialized nature of the study we will not review them here. Nor will we discuss the selection of suitable domestically available frames, since it was dealt with in earlier discussions. We may recommend the BV 24 protective glasses (produced by OKULA Nyrsko and supplied by REMPO Kromeriz), in which the first pair of lenses can be removed. By mounting either both pairs or only a single pair of filters (as described below) we obtain suitable glasses for protection against laser light, which can be used even by those who wear corrective eyeglasses.

1. The Current Situation

The usual design makes use of absorption filters (colored glass, plastics) whose optical density in the wavelength region in question results in a permissible level of direct irradiation of the eyes. Despite its many advantages (simplicity, mechanical durability, low price and the like), this method generally gives a relatively low transmissivity in the visible region outside the suppression band. As a result, such glasses are often taken off because of poor visibility in the laboratory and because of the need to follow the track of the beam (for example, when adjusting it), so that the eyes have no protection at all.

2. Proposed Solution

A higher transmissivity outside the suppression band can be achieved by using interference mirrors adjusted in the same way as laser cavity mirrors. However, there remain considerable secondary interference maxima, which frequently limit transmissivity in the middle of the visible region where the human eye is at its most sensitive. Leveling out the fluctuations in the interference curve and increasing the transmissivity gives the interference filter a relatively steep boundary (high-frequency transmission, low-frequency attentuation), with a suppression band practically the same as with the mirror described. Fig. 1 shows plots of measurements on such filters for normal and 30° incidence (in the vicinity of the transmission, minimum additional measurements were taken with higher sensitivity; the interval marked "0.1%" shows the scale graduation).
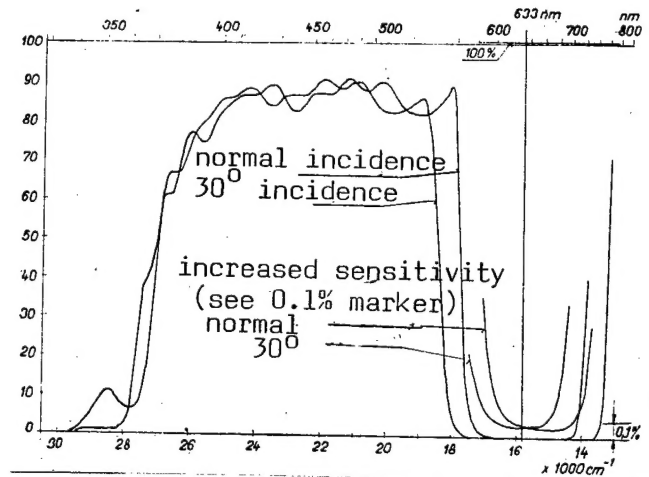
Fig. 1. Eyeglass filter for protection against light of continuous-wave He-Ne laser (50 mm diameter)

The smaller degree of suppression (τ = 0.05 percent) at the exposure wavelength of 633 nm may be a relative disadvantage of this type of filter. But by using two filters in sequence, for example, we achieve satisfactory levels, while the transmissivity outside the suppression band remains very good (satisfactory): (for our filter, from Table 1, $\tau = 0.85^2 = 0.72$).

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Table 1. Transmissivity of filters for protection against continuous-wave He-Ne laser (λ = 633 nm), for lasers developed by CSAV-UPT Brno. Calculated for E_d = 3 x 10^{-7} W . cm^2, critical values are for E_{kr} = 2.5 x 10^{-3} W . cm^2, t = 0.25 sec.

Type of laser Typ laseru	Characteristics of laser Parametry laseru					Direct irradiation Přímé ozáření			Indirect irradiation Nepřímé ozáření		Dazzling Oslnění trubicí by tube	
	L_{res}	Φ	d_{sv}	S_{sv}	E	τ_p	$\sqrt{\tau_p}$	τ_{pkr}	τ_{n25}	l_{min}	l_{kr}	$\bar{\tau}$
	mm	mW	mm	mm²	W.cm⁻²	%	%	%	%	cm	cm	%
LA 1001	2000	80	3,0	7,07	1,13	$2,65 \cdot 10^{-5}$	$5,15 \cdot 10^{-2}$	0,22	0,74	291	3,2	7,4
LA 1002	1400	40	2,20	3,80	1,05	$2,85 \cdot 10^{-5}$	$5,34 \cdot 10^{-2}$	0,24	1,47	206	2,3	
LA 1003	450	6	1,15	1,04	0,577	$5,19 \cdot 10^{-5}$	$7,20 \cdot 10^{-2}$	0,43	9,82	80	0,8	
LA 1000	138	0,8	0,86	0,58	0,138	$2,18 \cdot 10^{-4}$	$1,48 \cdot 10^{-1}$	1,82	73,6	29	0,3	

Note: The quantity $\sqrt{\tau_p}$ gives the transmissivity of a single filter used to determine τ_p for two filters in sequence.

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In the laboratory, when the laser tubes cannot be provided with a cover during experimental work, protection against spontaneous-discharge radiation is also a concern. What is required is to decrease the brightness of the tube surface to prevent dazzling. In the case of a He-Ne laser it is desirable to suppress the region above 560-570 nm (up to 650 nm), where the extremely intense line spectrum passes over into a band spectrum (in spectrometric terms; in other words, the discharge has an orange-red color). The emission spectrum in the visible region below 560 nm fortunately has a very low intensity, and the ultraviolet region below 340 nm, with its negative biological effects, is also limited, particularly by the glass base of the lenses. The protective filter also meets the requirements related to prevention of dazzling by the tube; the intense and undesirable parts of the discharge spectrum are virtually all included in the suppression bands, and there is no significant disruption of good visibility in the laboratory (a quantitative verification is provided in the calculations below).

3. Analysis of the Problem and Recommended Measures

In procedural terms we will discuss eye protection under the following headings:

3.1. Directly incident radiation:

   3.1.1 Decreasing the intensity to permissible (harmless) level;

   3.1.2 Critical momentary (t = 0.25 sec) exposure value for eyes

Note: Radiation reflected by a mirror may be considered equivalent to directly incident radiation, because from a safety standpoint a reflectivity close to 100 percent cannot be ruled out.

3.2. Indirect radiation in observation of the track of a diffusely reflected beam (assuming maximum diffuse reflectivity and uniform, i.e., Lambert, scattering):

   3.2.1 Decreasing irradiation intensity to a permissible level:

      (a) observation from usual viewing distance (1 = 25 cm);

      (b) minimal observation distance without attenuation by filters;

   3.2.2 Critical momentary (t = 0.25 sec) eye exposure without filter attenuation

3.3. Prevention of dazzling during direct observation of laser discharge tube:

Even though adequate laboratory lighting can be assured during work with lasers, nonetheless for safety we must assume that the beam diameter is always smaller than the diameter of the pupil; in addition, the divergence

of the beam is negligible. Thus natural eye protection is of no importance, and we always plan on full (nominal) laser power.

3.1. Directly Incident Radiation

3.1.1. Decreasing the Irradiation Intensity to a Permissible Level

The transmissivity τ_p of the filter is governed by the requirement to decrease the intensity E of irradiation by the laser beam to a permissible level E_d:

$$\tau_p = E_d/E. \tag{1}$$

Since generally the radiant flux (power) Φ (W) of the beam and the beam diameter d (cm) are known, we can calculate the irradiation intensity E:

$$E = 4\Phi/\pi d^2 \text{ (W . cm}^{-2}) \tag{2}$$

and we can correct equation (1) accordingly:

$$\tau_p = 0.75 \ \pi \ . \ 10^7 \ . \ d^2/\Phi, \tag{1a}$$

where we have taken $E_d = 3 . 10^{-7}$ W . cm^{-2} in accordance with current recommendations.

3.1.2. Critical Momentary Eye Exposure for Directly Incident Radiation, t = 0.25 sec

This situation is considered only in foreign regulations, and accordingly for our conditions the irradiation intensity value E_{kr} given below is intended only for information purposes as the maximum possible value in emergencies. Equations (1) and (1a) apply for the filter transmissivity τ_{kr}, while we use instead of E_d the value $E_{kr} = 2.5 . 10^{-3}$ W . cm^2 (for t = 0.25 sec):

$$\tau_{pkr} = 6.25 \ . \ 10^{-4} \ . \ d^2/\Phi. \tag{1b}$$

Note: The calculated transmissivity may perhaps be taken to be the overall maximum transmitted by protective eyeglasses, even though a higher value might be permitted, for example, in observing the track of a beam on a scattering surface (as discussed below). Protection against an accidental (unanticipated) direct incidence would then not be fully lacking, assuming that the blink reflex would not take longer than 0.25 sec.

3.2. Indirect Radiation, Observation of Track of Diffusely Reflected Beam

3.2.1. Decreasing Irradiation Intensity to a Permissible Level

The diffuse reflectivity of surfaces (on which the laser beam is incident) is assumed to be maximal in terms of power, and uniform, i.e., Lambert, scattering is assumed. Generally all surfaces which scatter light

sufficiently so that there are no visible specular glints are considered to be Lambert radiators. Thus not only do we follow current usage, but the computation which gives sufficient precision is a simple one (the errors will be far below the safety level used in establishing the permissible radiation intensity $E_d = 3 \cdot 10^{-7}$ W $\cdot$ cm^2: for example, the value $E'_d = 10^{-6}$ W $\cdot$ cm^{-2} given in reference 3 [references not reproduced] indirectly confirms this view).

The brightness distribution of a Lambert surface is usually represented by a sphere tangent to the surface, and thus we can represent the high-irradiation intensity E_n by the ratio of the radiation flux Φ of the laser beam and the surface of the sphere $S_k = 4\pi(\ell/2)^2$, where ℓ is the distance from the eye to the scattering surface:

$$E_n = \Phi/S_k = \Phi/\pi\ell^2 \quad (W \cdot cm^{-2}) \tag{3}$$

The equation for the transmissivity of the protective filter with perpendicular observation of the track of the laser beam (this is the lowest value: at other angles the transmissivity increases with the cosine of the observation angle) will be similar to equation (1):

$$\tau_n = E_d/E_n \tag{4}$$

When the level of E_n from equation (3) is reached,

$$\tau_n = 3\pi \cdot 10^{-7} \cdot \ell^2/\Phi \tag{4a}$$

and a correction for the conventional observation distance $\ell = 25$ cm gives

$$\tau_{n25} = 1.875 \; \pi \cdot 10^{-4}/\Phi \tag{4b}$$

The minimum distance ℓ_{min} for observing the track of the beam without a protective filter (for $E_d = 3 \cdot 10^{-7}$ W $\cdot$ cm^{-2}) is given by equation (4a) for a filter with transmissivity $\tau_n = 1$:

$$\ell_{min} = 1.826 \cdot 10^3 \cdot \sqrt{\Phi}/\sqrt{\pi} \quad (cm) \tag{5}$$

In the laboratory this protection ("distance protection") is considered important only in the case of low-power radiation; at high powers the distances are rather large.

3.2.2. Critical Momentary Eye Exposure Without Protective Filter

We obtain the critical minimum distance ℓ_{kr} from equation (4a) by substituting $\tau_n = 1$, $E_d = E_{kr} = 2.5 \cdot 10^{-3}$ W $\cdot$ cm^{-2}:

$$\ell_{kr} = 20 \; \sqrt{\Phi}/\sqrt{\pi} \quad (cm). \tag{6}$$

As in the case of direct eye exposure, we must recall that this situation cannot be allowed, and the figure is given only for information purposes. Fortunately, for lasers with power levels below 100 mW the critical distances

are very small ($\ell_{kr} = 3$ cm); thus, with good worker discipline there need be no danger. We assume exposure until blinking (0.25 sec).

The transmissivity of protective filters (for 633 nm) calculated from all of the points of view described above for the series of He-Ne lasers produced by CSAV-UPT [Institute of Instrument Engineering, Czechoslovak Academy of Sciences] are given with their characteristics in Table 1.

3.3. Prevention of Dazzling During Direct Observation of Discharge Tubes of He-Ne Lasers

It is well known that dazzling occurs when observing a discharge tube. It may be described as vision-limiting, which at its mildest causes considerable difficulty in seeing or overall fatigue for a long period. It can be eliminated only by decreasing the brightness with eyeglasses, if a protective covering on the tube cannot be used. In our discussion we will take account of the relative transmissivity of the protective filter in the range where it attenuates the beginning of the intense (undesirable) part of the discharge spectrum (560-570 nm) and the beginning of its suppression band (about 600 nm). We do not consider the remainder of the discharge spectrum above 600 nm, because this falls entirely into the range of minimum filter transmissivity ($\tau \leq 1\%$), as follows from its nature.

In our computations we use the Netusilov formula for the dazzle factor G as specified by Czechoslovak State Standard 36 0008. Its target value is 25 or greater (for work in workshops or offices, for the field of vision with the usual direction of sight):

$$G = K \cdot B \cdot \omega^{0.4}/L^{0.5}, \tag{7}$$

where K is a factor giving the position of the dazzling object in the field of vision and is equal to 1 if the source is on the visual axis; $B = E_t/\omega$ is the average brightness of the dazzling object for perpendicular incidence on the eye (in nits), E_t is the average irradiation of the dazzled eye by the source (the tube), in nits; $\omega = S/\ell^2$ is the solid angle of vision in which the eye sees the dazzling object (in steradians); S is the visible projection of the object as seen from the eye (cm^2); ℓ is the direct distance from the eye to the source (cm); $L = E\rho/\pi$ is the background brightness in nits; ρ is the diffuse reflectivity factor (for cream-colored plaster, $\rho = 0.70$); and E is the average background irradiation (in lux).

It follows from the foregoing that to calculate G from equation (7) it is sufficient to know the illumination from the tube E_t and the background brightness L. The measurements are made with a luxmeter.

Example of Calculation of the Dazzle Factor

We normalize the distance of observation to the tube to the conventional distance of 25 cm.

The diameter of the tube (or discharge) is $d = 3.6$ mm (for the LA 1001 laser with a power of 80 mW).

The length of the tube (or discharge) is determined for the maximum power for the optimum visual angle of the eye $\alpha = 2 \times 60°$ (we do not allow for a decrease produced by eyeglasses because this is not universal):

$$a = 2 \ell_0 \tan \alpha = 2.25 \tan 60° = 86.60 \text{ cm.}$$

The solid angle ω of vision is:

$$\omega = a \cdot d/\ell_0^2 = 86.6 \cdot 0.36/25^2 = 4.99 \cdot 10^{-2} = 0.05 \text{ steradians.}$$

We calculate the laboratory background brightness L from the measured average illumination value E and the average diffuse reflectiveness ρ of the back wall, which is our case were $E = 80$ lux and $\rho = 0.5$, estimated for a cream-colored wall where part of the surface consists of the opal glass of the housing:

$$L = E\rho/\pi = 80 \cdot 0.5/\pi = 12.73 \text{ nt.}$$

We determine the brightness of the tube (or discharge) B from the illumination of the dazzled eye by the source (at the location of the eye), $E = 200$ lux (measured) for $\ell = 25$ cm:

$$B = E_t/\omega = 200/0.05 = 4000 \text{ nt.}$$

Thus the dazzle factor G will be

$$G = K \cdot B\omega^{0.4}/L^{0.5} = 1 \cdot 4 \cdot 10^3 \cdot 0.05^{0.4}/12.73^{0.5} = 339.$$

Decreasing the calculated value to the guideline value $G_s = 25$ requires attenuation of the brightness by a filter with an average transmissivity

$$\overline{\tau} = G_s/G = 25/339 = 7.37\%.$$

This requirement is met by a single protective filter as described in Fig. 1, because the average transmission in the range 560–600 nm is considerably lower. As noted above, the calculation was made for the laser tube with the highest power, so that the conclusion is valid for the entire series presented in Table 1.

4. Suggestion for Design of Protective Eyeglasses, Especially for Research Laboratories

In a laser research laboratory it is frequently necessary to give priority to the observation of a diffusely reflected laser beam. A resulting requirement is good visibility of the track during any kind of adjustment or experiment, a condition which cannot always be met with a protective filter whose transmissivity for the exposure wavelength (633 nm) is chosen so that the density of two such filters in a row will meet the permissible

irradiation intensity conditions for direct incidence. This requirement is suitably met down to about 1/20 of the transmissivity value given by the calculation for observation of a scattered beam from the conventional observation distance. For a lower transmissivity, however, observing the beam will be difficult (this was determined in subjective tests with personnel who were involved). Under our conditions, the need is met by the transmissivity of filters which when doubled provide sufficient attenuation of direct incidence only in the case of the LA 1001 laser (80 mW), and possibly for the LA 1002 (40 mW). In the other cases, to preserve complete protection, i.e., unchanged transmissivity of the double filter, when increasing the transmissivity of one pair of filters for observation of the scattered track it is necessary to decrease the transmissivity of the other pair by a suitable amount. On design and production grounds, this condition is very difficult to meet with two pairs of filters, because the number of surfaces in a single system would increase disproportionately. But the requirements can be met with three filters (i.e., pairs), with the pair for high density produced by coating both sides of one lens. In the eyeglasses (e.g., B-V 24 and the like) they would be located in the removable part, and their removal would result in protection only against indirect irradiation, i.e., observation of a scattered track.

Given the power range shown in Table 1, we need to have at least two types of protective eyeglasses (or filters), as follows:

a. For the 80-mW LA 1001 laser and possibly the 40-mW LA 1002 laser.

The use of two pairs of identical filters with a transmissivity of 0.05 percent gives both protection against direct irradiation of the eye $(0.05\%)^2 = 2.5 \cdot 10^{-5}\%$) and adequate visibility of the scattered track of a laser beam in the case of one pair of filters.

b. For the 6-mW LA 1003 laser and possibly the 0.8-1 mW LA 1000 laser.

If we require that the transmissivity of one pair of filters give good visibility of the track of a beam with a power of at least 6 mW, we can provide direct-incidence protection with three pairs of filters. The first and second pairs, applied to a single lens, are mounted in the removable section of the glasses, while the fixed part has a filter with the proper transmissivity for observing the track (the third pair). The conditions are met by the following set:

$$\tau_1 = 0.05\%; \quad \tau_2 = 3\%; \quad \tau_n = 3\%,$$

whose total transmissivity of

$$\tau_p = \tau_1 \cdot \tau_2 \cdot \tau_n = 4.5 \cdot 10^{-5}\%$$

gives a suitable density for direct incidence up to 7 mW. A minor difficulty is the low transmissivity outside the suppression band (the average transmissivity in the blue and green part of the spectrum is $\bar{\tau} = 85\%$ for one filter and $\bar{\tau}^3 = 60\%$ for three). However, this set yields a considerably higher optical density in the exposure part of the spectrum.

The condition of full-day use of protective eyeglasses can be well met with a certain limitation (light-tightness of side flaps) by the frames of OKULA's model B-N 23 or B-N 25 protective glasses (the variant with an insert for corrective diopter glass), in which we installed the suitable protective filters instead of the original glass. Since these glasses are equipped with a removable part (as in the B-V 24), we can produce not only a suitable basic system as proposed for the B-V 24 glasses, but also a number of special-purpose combinations. Certain suitable arrangements are shown in Table 2.

Table 2. Some eyeglass sets for protection against light of continuous-wave He-Ne laser (633 nm) using B-N 23 (25), B-V 24 or B-A 24, B-N 30 (32) frames

1 Propustnost použitých filtrů (633 nm)				2 Ochrana pro			
3 pevná	sklopná část 4 brýlí		cel- 5 kem	6 mezní výkon laseru	ozáření 7		8 Pozn.
τ_n	τ_2	τ_1	τ_p		přímé 9	ne- 10 přímé	
%	%	%	%	mW	for τ_p	for τ_n	
0,05	0,05	—	$2,5.10^{-5}$	80	yes	yes	Základní (univer- zální) provedení 11
3 %	3 %	0,05	$4,5.10^{-5}$	7	yes	yes	
3 %	bez sklopného dílu 12		(3 %)	7	ne- chrání 13		B-A 24, příp. B-N 30 (32) 14

Subscripts 1 and 2 denote the filter surfaces on the removable lens in the order in which the incident beam reaches them.

Subscripts p and n are used as in the text and Table 1.

Key:
1. Transmissivity of filter (633 nm)
2. Protection against
3. Fixed
4. Removable part
5. Total
6. Maximum power of laser
7. Type of irradiation
8. Note
9. Direct
10. Indirect
11. Basic (universal) design
12. No removable part
13. No protection
14. B-A 24 or B-N 30 (32)

As the table shows, in the case of protection only for observation of a diffusely reflected laser beam the removable section can be removed or a type without it used. In this case the light-protective eyeglass frames, especially of type B-A 24 or possibly B-N 30 or B-N 32 (with an insert for diopter glass) are usable, since they are fully suited to "permanent" use.

If corrective diopter glass is used, the coating (the filter) is applied directly to them (ideally to the inner side). Naturally, however, we must note the consequences of limited light-tightness of the frames around the eye and particularly the partial nature of the eye protection; this fact is known to specialists as regards the initial condition. In practice, however, it will be necessary to use at least double lenses in most cases, depending on the type of protection required and the power of the lasers being operated.

Because of the incompleteness of protection, however, the last-mentioned design is generally debatable, and its use is not recommended for the laboratories of ordinary users, because it does not meet the main conditions of eye protection against a directly incident beam.

Discussion and Conclusions

In this study, we have tried to analyze from every important angle the protection of vision against the effects of continuous-wave He-Ne lasers, examining not only questions related to the laser beam itself (633 nm) but also the effect of spontaneous radiation from the discharge tube (which is important for laboratory practice when for any reason an instrument cover cannot be used).

According to recommendations, the protective glasses are provided with dielectric protective interference filters, which may be the only type to meet the main condition of good visibility in laboratory work, i.e., good transmissivity in the visible range outside the suppression band, including the advantage of a steep boundary. Thus the condition that the workers not take their glasses off for any type of work, thus exposing themselves to danger, is met.

As already noted, the selected B-V 24 (or B-N 23 or B-N 25) frames allow very good attenuation with two pairs of filters, the first of which is removable. This makes it possible to observe a scattered laser beam with reliable sight protection (i.e., transmissivity combined with the required attenuation; when two filters, one behind the other, are used, i.e., the basic arrangement, the transmissivity for directly incident light is so low that the beam track generally cannot be seen at low powers). In other work with lasers, however, to assure complete protection it is necessary to use both pairs of filters, with the exception of the single-frequency LA 1000 laser, as can be seen from Table 1.

A comparison of the calculated transmissivity values for the exposure wavelength (633 nm) with Table 1 (measurements of spectral transmissivity of the protective filter) shows that the combination of two filters essentially achieves the values required for a direct beam from the LA 1001 laser with a power of up to 80 mW ($\sqrt{\tau_p} \cong \tau_{633}$). For oblique incidence of the laser beam, the design of the B-V 24 frames allows a maximum incidence angle of 30°, and the filter may have a higher overall transmissivity, because its spectral dependency is shifted. In particular, the protection against direct incidence of the laser beam may have some limitations in such a

filter (in the extreme case, meeting the maximum permissible irradiation intensity $E_d = 10^{-6}$ W . cm^{-2} recommended in reference 3). The solution of this problem is not, however, a basic difficulty: the requirement of complete attenuation can be met even with oblique incidence by an adjustment giving the same transmissivity for direct and indirect incidence, or by simultaneously adding to the sedi design of the system.

We must emphasize that we could have arrived at this new concept in eyeglasses for protection against continuous-wave He-Ne laser light only with the cooperation of personnel of the thin films laboratory of Meopta Prerov, led by RNDr Z. Knittl, CSc. The author takes this occasion to express his wholehearted thanks.

Glasses of this design manufactured as part of the state research assignment of designing an interference coating for laser engineering have been successfully tested in practice.

Note: An objection to the use of protective interference filters in protective eyeglasses is the idea that in group work it is impossible to prevent reflection of the laser beam from the filter of one worker into the eyes of another, because the protective filters have high reflectivity in the suppression band (the high density is for reflectivity, not absorption). This is, however, unimportant, because during work all personnel would be required to wear protective eyeglasses, which are suitable for direct irradiation and thus for a beam after specular reflection. While the absorption filters have a reflectivity which is an order of magnitude lower (two surfaces) than air, even in this case the reflected beam is little attenuated by specular reflection.

8480
CSO: 2402/4

METALLURGICAL ENGINEERING PLANT TO USE WELDING ROBOT

Prague HOSPODARSKE NOVINY in Czech 15 Oct 82 p 7

[Article by Eng Josef Pajer, CKD (Ceskomoravska Kolben Danek) in Kutna Hora]

[Text] The CKD manufacturing establishment in Kutna Hora is one of the rela-
tively new establishments of the metallurgical engineering type. In addition
to its main production line, namely production of steel castings, it also pro-
duces a large volume of various weldments. We have completed successfully
several rationalization drives by putting into operation single-purpose welding
machines of our own design and manufacture. We have already exhausted facili-
ties of mechanizing straight line and circular welds by using hard automation.
The next step can be made by mechanized welding in making welds running in any
desired spatial direction. It is possible to follow this trend precisely by
using an industrial robot.

Having acquired the first specific items of information about the use of robots
for welding, we have evaluated the feasability of using a robot on an industrial
scale. At present, we are already providing for an executory project and for
individual components of the entire workplace.

The important initial step is to decide on the type of the entire workplace,
whether we shall purchase it from foreign countries, mostly nonsocialist coun-
tries, or whether we shall build it gradually from domestic resources. In our
case, we made a decision in favor of the second alternative, which does not
involve any demand for foreign exchange.

In assessing the value of the weldments, we took into consideration the dimen-
sion of a weldment, its weight, the welding technology used, accessibility of
the welding place, precision of the stitching or assembly of a weldment, and
the produced quantity of weldments. After we had worked out an exploratory
questionnaire, we submitted several standardized weldments for evaluation by
the VUKOV [Metallurgical Research Institute] in Presov. VUKOV made the selec-
tion for the initial application. A weldment of the lower swing arm for the
SAVIEM car was selected as the most suitable type. It can be characterized as
follows:
--the weldment is composed of castings of KOHAL sheet metal 3.5-5 millimeters
thick;
--the weight of the weldment is 14.5 kilograms;

--the contour dimensions of the weldment are 630 x 350 x 105 millimeters;
--welds made in a protective atmosphere of CO_2 are easily accessible;
--the quantity manufactured in monthly volumes is 2,000 pieces;
--the labor consumption of a welding operation is 0.334 Nh [newtons per hour];
--the accuracy of assembling a weldment is $\pm$ 0.9 millimeters.

In order to determine the last point, that is, the repeatability of the accuracy of the weldment composition, we made exact measurements of 30 stitched weldments on a new DEA coordinate-measuring machine. On the basis of 4,500 measurements, we have evaluated the mean deviation at $\pm$ 0.9 millimeters. In view of this relatively unfavorable result, we are forced to take steps during operations preceding the actual welding, in order to achieve a higher repeatable accuracy. We are providing for new pressing tools and rebuilding the stitching preparation. After the VUKOV Presov had selected for us the most suitable weldment for the robotized welding process, it processed the Basic Technical-Economic Assignment containing all the necessary data for an evaluation of the feasibility of the system, including an economic evaluation of it. This evaluation also includes a harmonogram of the construction of the entire workplace, and we are trying to maintain this harmonogram in reference to deliveries of individual components. The proposed time limit for delivery is 1984. We continue to cooperate with the VUKOV in Presov, which is now processing the executory project for us and arranging for the delivery of the PR-32 E robot with a control system.

The proposed design of the workplace calls for a whole series of peripheral installations. Provisions for these peripheral installations are among the most demanding preparatory stages of the construction work.

It should be noted that no domestic supplier delivers the workplace as a whole. In our case, for example, we have not solved as yet the problem of delivering the DOM 200 two-table rotary manipulator. Its manufacturer, the ZTS [Heavy Machinery Enterprise] in Detva, expects to give priority in its production to the requirements of its own VHJ [economic production unit] ZTS. We are getting the semiautomatic machine with a programming unit from Kovoplast in Nitra and the RMS 63 manipulator from the Bratislava Automobile Works. We are using our own resources to get the remaining equipment for the workplace, such as suction and clamping devices and safety equipment to prevent accidents. It is for this reason that construction and production facilities have to be made available. Provisions for individual components are directly related to the question of their reactivation and to operational guarantees in the composition of the entire workplace.

Technological use of an industrial robot for arc welding represents one of the most demanding applications. Welding cannot be compared, for example, to manipulation. I believe that precisely those workers who do the welding and who are aware of how demanding this technology is in terms of manual operations can see great opportunities in the use of robots. They were also among the first workers who cooperated closely with the CSVTS [Czechoslovak Scientific and Technological Society] and considered the possibility of using industrial robots. However, the situation is quite unsatisfactory at present with regard to welding in terms of procurement of basic aids and equipment. This situation puts in a

paradoxical position our efforts to use the most modern technology. Welders themselves reproach us, for example, for preparing the use of robots, when at the same time they do not have electrode holders which they unconditionally need for their work. Nevertheless, we are trying to inform the broadest strata of the working people in the form of lectures and excursions precisely about the opportunities and all advantages of robotization, because support and initiative by the working people is very helpful in the implementation of the program, and we have to count on it. In the meantime, a point which continues to remain unsolved in our case is professional handling of the operations at our workplace in reference to "control system--industrial robot--next peripheral system." It will be necessary to get and train a specialist for the used system which belongs to a new generation, a specialist in electronics who will take care of the system's maintenance and eventual repairs. The personnel at the workplace will receive specialized training and will be selected from among a number of experience welders, because the job involves a demanding technological application and requires professional supervision and thorough operations control. We want to use this first workplace for testing all matters related to the application of an industrial robot. We have now selected additional weldments for which it would be possible and economically advantageous to use an industrial robot. At the same time, we have now worked out a study of the possible use of industrial robots for polishing operations (finishing of castings).

I assume that every builder will encounter the following problems:

One general contractor alone will not deliver the entire workplace. This involves procurement of individual components and reviving and maintaining smooth operation of the workplace.

One must expect to use qualified construction and production facilities for the manufacture of fixtures and atypical positioning devices.

The basic problem of introducing robotization in welding is how to provide for repeated accuracy of assembly and positioning of the weld surfaces.

One must expect a different labor organization at the workplace: continuous feeding and removal of weldments, technical aspects of programming and maintenance of the workplace.

There is no other way except using the initiative of the working people. One must also count on active support by the management of the enterprise, party and trade union organs, and take advantage of the initiative of CSVTS members.

5668
CSO: 2402/7

PROBLEMS, GOALS OF TECHNICAL DEVELOPMENT NOTED

Budapest MŰSZAKI ELET in Hungarian 28 Oct 82 p 5

[Excerpts from speech by Gyula Szeker, chairman of the National Technical Development Committee: "Technical Development and the Technical University"]

[Excerpts] This year the Budapest Technical University is celebrating the 200th anniversary of the founding of its predecessor, the Institutum Geometrico-Hydrotechnicum. A celebration was held for this occasion on 13 October in the assembly hall of the university with the participation of Istvan Sarlos, member of the Political Committee of the Hungarian Socialist Workers' Party and deputy chairman of the Council of Ministers, and Bela Kopeczi, minister of culture.

The series of celebrations being held on the occasion of the 200th anniversary of the Budapest Technical University continued the next day with a scientific session. Karoly Polinszky, rector of the university, opened the session. Speeches were then given by Andras Korcsog, Gyula Szeker, Lenard Pal and Pal Tetenyi.

We here publish excerpts from the talk by Byula Szeker. In our next issue we will give a compilation from the other three speeches.

The place and the occasion alike prompt me to speak of the current and future problems of technical development. The 200 year old Budapest Technical University and its predecessors have been for a long time among the most qualified depositaries and greatest institutions of Hungarian technical progress. They have enriched our technical knowledge with inestimable values and the theories, inventions and innovations born within these walls have formed our thinking.

It seems strange to emphasize the importance of technical development at the Technical University. Today the entire world is striving to re-examine

and reformulate according to the requirements of the age the methods, guidance and institutional system of technical development. It would be an erroneous simplification if we were to feel that a good economic policy could itself produce correct technical development. It would be similarly erroneous to take the position that a good general policy starting from the sphere of the economy would automatically give birth to correct guidance methods.

Strengthening the innovative readiness and capability of the economy and accelerating technical progress are key questions of our development because only in this way can we increase the ability of our economy to perform. Strengthening profit interest and the entrepreneurial spirit are essential conditions for the acceleration of technical development. But research and technical development cannot rely exclusively on the self-regulation of the market (and cannot be regarded exclusively as an enterprise task either); thus, the state must undertake a guiding and mobilizing role with an optimal combination of market self-regulation and state guidance.

Technical development is fundamentally an enterprise task; that is, the enterprise is responsible for the direct conduct of technical development. This responsibility cannot be given to another, so the enterprise must have those resources in the possession of which it will be capable of realizing technical development. At the same time, even the most liberal capitalist countries raise technical development to the state level in some way, as the most important tool for long term survival, for competitiveness, for preserving or winning a position.

Thus, in the new value order of the world economy developed technology has gone up in value. As the intellectual work content of production has increased, intellectual resources have gone up in value also and products with a high content of intellectual work have become the focus of development.

Central developmental programs have an important role in the realization of the strategic goals of technical development. These very important developments requiring large investments cannot be selected and cannot be financed only on the basis of short term market requirements nor do they affect only one or two enterprises. Carrying out these programs requires the coordinated work of several guiding organs and a number of enterprises, often belonging to different branches. Let us think, for example, of the many-sided aspects and effects of the computer technology, electronics, petrochemical and pharmaceutical and crop protection materials programs.

There is a close link between the innovation readiness of society and the preparation of the technical intelligentsia. Unfortunately the social prestige of the technical intelligentsia has decreased. In general the engineers do not complain about the lack of material recognition but rather about the insignificance of engineering work, about the limits on personal development and advancement and about the fact that in a significant part of their working time they do not carry out engineering tasks.

The income situation, way of life, general and professional culture and morale of the technical intelligentsia have a crucial influence on technical development. Thus it is an important task for us to put an end to the decrease in the social prestige of the technical intelligentsia.

I feel that it would be proper for us to review briefly what sort of technical development tasks we must solve by the end of the century to ensure our economic growth.

First place in development must be given to those areas which will help modernize the economic structure outside their own sphere as well. Our homeland is not capable of competing along the entire front of technical development and activity. We must select points of emphasis. It is very important that we recognize in time the more significant areas for this emphasis.

The areas to be examined and treated in a stressed way from the viewpoint of the development of our economy might be:

--electronics, systems of tools and solutions for information transmission and processing;

--biological technologies of outstanding importance connected with agriculture, from the viewpoint of techniques now known and possible in the future; and

--those branches of industry which have critical technological areas for quality.

Let me give a few examples in regard to our more important problems and the chief goals of technical development. The idea has spread recently that as a whole the mineral and raw material situation of Hungary is more favorable than we had thought. This is true, but on the basis of an international comparison our situation can be classified only as weak.

We must develop our long-range plans so that our energy use up to the end of the century can increase by only one-quarter as compared to today. We must reckon with a similar situation in raw and primary materials supply up to the year 2000. For us, energy savings achieved through technical development are a profitable energetics investment. If we raise the efficiency of our energy use only to the level already achieved by developed industrial countries we can achieve a saving of 20-30 percent.

The oil price explosion has cast a new light on energetics. Extreme views began to circulate concerning the energy supply of the world after the two price explosions. In the meantime, however, it became clear that, while we need not fear the early exhaustion of the energy resources available in the world, the age of cheap and secure energy supply is over.

Rational use of fuels is fundamental in our economic policy. We should constantly adjust the structure of our energy use, reducing the ratio of

liquid fuels and increasing the coal, natural gas and nuclear energy sources.
The most effective way to use the domestic coal is in the production of
electric power which, together with nuclear energy, will take the place of
oil products.

The biggest problem of our ferrous metallurgy is that there is a high
proportion of SiO_2 in the iron ore processed, an average of 20 percent.
Thus, in a blast furnace, we get 850 kilograms of slag for 1,000 kilograms
of pig iron, and this is more than double the amount of slag in west European
blast furnaces. Thus we use 30-40 percent more coke for our pig iron
manufacture.

We must increase the ratio of our quality steel production from the present
10 percent to 25-30 percent with steel works developments to be completed.
Expansion of the production of so-called secondary products cannot be post-
poned; these are metallurgical products requiring a higher degree of
processing (cold rolled sheet and strip, cold drawn rod and wire, cold
formed profiles, welded pipe, and tinned, zincked and plastic coated
products). By the year 2000 we want to double production of these products
through our developmental program.

The technical development and further expansion of our aluminum industry,
based on our bauxite deposits, will serve our raw material supply as well
as the interests of our economy as a whole. The Hungarian-Soviet aluminum
industry agreement has proved mutually very effective and we must strive
to continue this cooperation in the future also.

The situation in machine manufacture technology has changed radically in
the past one-two decades in that electronics has made possible the "NC
technology" solutions. Operations performed by various items of equipment
can be ordered into a single centrally controlled process, generally
controlled by computers.

Electronicalization--the broad penetration of electronic devices into every
branch of the economy and the most varied spheres of society--is a world
phenomenon. The foreign competitiveness of our products depends more and
more on the electronics used in them. We must create a base for our
electronic parts industry, the basis for which is provided by the "Electronic
Parts and Subassemblies Central Development Program" approved by the Council
of Ministers in 1981. But we must also create a receptive culture,
preparing the users, which requires a new attitude from economic and technical
experts and leaders alike.

Metal cutting remains the chief technology for machine manufacture, although
the share of plastic forming may increase.

The manufacture of highway vehicles has the highest volume in the
production structure of our machine industry. Its foreign market positions
are significant in the socialist and other developing countries and the
headway it is making in a few developed capitalist countries merits
attention also. The chief goals of technical development here are material

and energy conservation, reducing harmful emissions, greater passenger comfort and accident safety and less need for maintenance.

The primary material base for domestic petrochemical production is the Leninvaros olefin works established within the framework of the Petro chemical Central Development Program.

Cooperation with the Soviet Union is expanding further. In accordance with a protocol signed in the first half of 1980 the Soviet Union will build, by 1986, an ethylene works similar to the Leninvaros works. By the end of the century it will deliver to our homeland, from its production, 60 kilotons of ethylene per year, through the existing pipeline. Up to 1986 ethylene will be exported but following that the ethylene remaining here and the imported ethylene will make it possible to double our annual production of synthetic materials.

Our conditions are favorable for improving the competitiveness of the Hungarian pharmaceutical industry and crop protection materials manufacture. We are working out a central development program for the purpose of further development, for the manufacture of pharmaceuticals, crop protection materials and intermediaries.

We must preserve the grain and rough fodders produced in crop production, primarily by chemical means. We must make them available to animal husbandry supplemented with feed supplements, vitamins and yield increasing materials. Specific fodder use can be decreased with fodder management modernized by the achievements of chemistry.

Standardized construction should expand in the further development of the construction industry so that production can be increased 1.5 to two times with existing tools.

So what do we expect from our old university in the decades ahead? There is so much to be done, but we have many engineers desirous of deeds. It would be difficult to choose which tasks to stress, on the solution of which tasks to concentrate our technical resources, difficult to say what the university can offer to this. One can only outline a few ideas here.

The need for technical progress, accelerated in the present world economic situation, requires something different from the educational system than what we are used to traditionally. It requires a new structure of information and mastering it at a higher level to be sure, but it expects that in addition to mastering the general basic information necessary for an understanding and further development of current technology it will make the maturing generation capable of an adequate forming of social-economic relationships. It must have as its goal the development of human behavioral forms, aptitudes and abilities which will make it possible for the young person to be capable throughout his life of throwing out obsolete information and mastering new.

A better unfolding of technical creativity is one of the conditions for getting rid of our inadequacies; and this requires much knowledge, creative abilities and a willingness to assume responsibility. We need engineers who know languages and have experience in economic questions, who are capable of recognizing the technical novelties appearing in the world and of using them, depending on their economic utility. Thus, in the future, we will need not more engineers but rather more talented engineers, with greater knowledge. In the training of engineers quality, not quantity, must be put in the foreground.

The present trends of our economic development provide little scope for great technical creations, for costly investments. But the significance of clever, good management is increasing, and the technical-economic intelligentsia can find their own role in this also.

In training our engineers it would be good to strive to see that the students got a broader view and more experience than belongs to their narrower speciality. On the one hand a sufficient degree and level of inter-disciplinary view will facilitate the cooperation of different sorts of experts, and on the other hand it would encourage accommodation to quickly changing technical development.

COMPUTER PROBLEMS, PRODUCTION, OPERATING TIME DESCRIBED

Computer Production, Operating Time

Warsaw ZYCIE GOSPODARCZE in Polish No 43, 14 Nov 82 p 12

/Article by Janusz Ostaszewski/

/Excerpt/ We supposedly produce one-third of the number of electronic sub-
assemblies per capita which Western Europe produces and this is not such a bad
production level. One may have doubts whether, in fact, this is really not
so bad, but on the other hand, when one considers how this part of electronic
production, which all over the world serves to boost businesses and is called
information science, is exploited in our country—one could well ask the ques-
tion whether we do not actually overproduce since it is wasted, anyway.

The regression in the production of computer hardware and in its applications
supposedly began somewhere around 1976. There exist today, it is true, some
3000 various computer information centers and this is almost double of the
number in 1975; however, only a few service what they should. A major por-
tion was organized in accordance with the voluntarism which was taking over
the economy and the state without any consideration for costs, needs, or the
preparation for computer use of those who were going to work with it. So it
is hard to know (as already mentioned) whether one should be saddened or should
should rejoice that production has fallen off. From the number of 105 com-
puters and 352 minicomputers in 1976 we have fallen, five years later, to 14
computers and 81 minis. In the ambitious plans and programs of dynamic
development we were also supposed to have had at least 5000 computers in-
stalled in 1980, and, according to some even more dynamic prognoses, even
10,000. In the end, they counted a year ago only 2633, out of which only
874 were large and medium computers. In the civilized world, at the outset
of our sad decade, there were 88 computers per 1 million inhabitants, while in
our country, four times fewer. The only consolation is that they do not devour
electricity and do not use up paper. For if there were more of them they
would probably be working on command "by the whistle" or they would be cover-
ing up the inertia of those who would hide their indolence behind the computer
just like their well-entrenched colleagues do.

Our Polish electronic brain does not get overworked. Just like the live one--
it ploughs through the 9.6 hour day and then rests. If it is a "teenage"

one--a minicomputer--it works only 4.8 hours a day and then goes home. There are even such lazy machines that, ever since having been imported for dollars several years ago, are still in a virgin state and are awaiting even better times

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And since, in spite of everything, here and there, certain of the complex programs managed somehow to get carried out, so they have managed to educate the personnel. And now they do what they happened to get, or were lucky to get, at the employment placement office. It is not known, either, whether they have managed to slow down this production of computer personnel who will not be needed for anything. It is known only that by 1990 there were supposed to be almost 30,000 with higher education and 50,000 with intermediate education. So if they are still in their respective schools today and are sweating over textbooks they better quit dreaming and switch to something more useful. For electronics is, indeed, an instrument of progress in every domain of economic life all over the world but that does not necessarily apply to the economic life in our country.

Industrial Computer Problems

/Article by Czeslaw Rybak/

/Text/ I would like to present here main problems of information science in industrial enterprises on the basis of experiences of a large machine producing establishment, namely Communication Equipment Production Plant PZL-MIELEC. I have observed that these problems are typical of many industrial enterprises where the digital computer constitutes an essential link in the system of information. I will deal with one of the main fields of application of information science in an enterprise, namely with automation of processing of data for management purposes.

Computerized information is broken down into organizational units assigned to leading activities (construction and technological services, management of the enterprise). Computer center with data processing equipment belongs to management service. This dependency determines the thematic range of data processing subsystems as to their operation, implementation, and design.

The computer center at the PZL-MIELEC is composed of three departments: digital computer operations, systems design and programming, and card punching machines (actually: mechanized input data preparation department). The center uses computer R-32. Available hardware is almost completely used up (the machine has been in use since 1977). This fact when linked with lack of spare parts (which are supposed to be supplied by ELWRO) markedly increases its unreliability. According to recorded data for 1981 average time of computer operation between succeeding failures was 1 hour 18 minutes. Not every malfunction brought down the entire computer or required repetition of calculations.

Poor technical condition of a digital computer forces adoption of such organizational solutions that assure processing on time and application of such technologies of processing that minimize losses caused by the necessity of repeating or re-starting of calculations. In order to assure processing on time the enterprise must undertake cooperation with nearest institutions which have computers of similar configuration. Well-designed processing technologies take into account computer configuration and hardware unreliability. For this reason magnetic tape units are limited to three and number of large (30 MB) direct-access disks to two. Programs with more than 1 hour of running time are required to include restart capability in case it becomes necessary to resume processing after a machine halt (unfortunately, large part of software purchased--mainly at ZETO centers--does not have such capabilities). In addition, limiting the number of tape units used by the system allows parallel processing (in two partitions of memory). The index of multiprogramming for 1981 was 1.8.

Vendors programs purchased outside or subcontracted to outside sources as well as many of the in-house written programs caused numerous difficulties during their implementation and during operation. It is particularly difficult to force or to carry out necessary organizational changes at the users of the system, particularly at those supplying the data, if they do not see obvious advantages from the application (necessary changes in current and historical documentation frequently require verification and supplementation of tens of thousands of data documents). In the case of implementation of relatively simple systems, when only one activity is cooperating with the computer center--one interested in automating some of its operations--introduction of changes necessary from the point of view of processing of data runs generally rather smoothly.

Experience acquired from implementation of many systems--both purchased and written in-house--allows to conclude that, to a greater or lesser degree, all the same errors always manifest themselves due to such causes as: inadequate correspondence of the processing model to the real world, incomplete data, data errors, small bugs in software. Due to this the most difficult phase of realization of the entire project is its implementation. It is in this stage, also, that a breakdown and abandonment of implementation most often occur. It is easier to overcome difficulties when implementing own software due to continuous contacts between user, system's designer, and programmers. Errors are corrected as they manifest themselves. Pursuit of the common goal resolves conflicts between people or between entire activities.

The qualification level of systems designers and programmers also becomes a problem. The systems designer, beside knowing problems of his own profession, must know well the area of operations of the enterprise for which he is designing the system, must know the organization and the conditions in which that enterprise is operating, and also must possess psychological disposition for communicating with the system's users. It is rather difficult to find persons fulfilling those requirements within the enterprise.

Often a person with many years of seniority in the enterpise who finished several courses in system design and programming becomes a systems designer.

If one compares this approach to the position of a systems designer with road that has to be travelled by a computer professional who does not know the specifics of the particular enterprise I come to the conclusion that computer professionals will master knowledge of a given business operation faster than a practical person will master computer science.

Personnel difficulties of computer centers of individual enterprises increased lately as a result of considerable fluctuation of staff personnel flowing mainly in the direction of ZETO /Main Center for Electronic Computer Equipment/. There one could earn much higher salary and additionally the work there is less tedious, "cleaner" than in the industry—it consists to a considerable degree of writing vendors software. The results of this outflow of personnel are still being felt in computer centers of individual enterprises, all the more so since it concerns mainly employees with highest qualifications.

Basic difficulties which system designers and application teams must overcome are caused by following organizational and human obstacles:

- source documentation not adapted to the requirements of the system

- incorrect index base (from the point of view of information science)

- considerable inertia of organizational structures

- passivity (and often simply resistence) of engineering and technical as well as administrative and clerical staffs

- relatively low level of organizational discipline

- slight (and often nonexistent) knowledge of computer science problems among engineering and technical staff.

The above-mentioned obstacles are not usually known to computer service centers, Even when contact between the industrial enterprise and the main computer center of the ZETO type is maintained it is most often done through representatives of that enterprise's computer services. There are cases when during a transition period it is necessary to maintain duplicate documentation: one that serves the existing information flow in the enterprise and another for the needs of the system being implemented. This demands additional work and discourages the user, especially when he is not particularly interested in the system being implemented. Data supplied by the user is then delayed, often incomplete, and full of errors. This, of course, is in turn reflected in the quality of produced reports. Since it is the computer services who supply those final reports they are blamed for poor quality of this information.

I am convinced that the main cause of the difficulties just presented is the lack of sufficient interest in the computer science shown by management of the enterprises who often protects and tolerates employees who refuse to submit to the discipline imposed by digital computers.

Most widespread breakdown of applications of computer science for management purposes is so-called deparmtental breakdown. It corresponds to the classical differentiation of basic activities of the enterprise such as:

- technical preparation of production
- materials management
- management of fixed assets
- employment and payroll
- production control
- finance and cost accounting
- sales of finished products
- management of tools.

The model of a computer system of the enterprise is constructed in accordance with this division. Within individual departments tasks, subtasks, and elementary functions are identified and they determine the division into systems, subsystems, and modules of the data processing system. In individual departments computer applications are at different stages of advanced development. This depends on the amount of interest that the management of those departments has in using data processing to automate simple but time-consuming clerical tasks.

Although department of technical preparation of production is that department from which systematic implementation of information system should begin (since it supplies original data from the point of view of control of other departments) it does not always get needed support from the management of the enterprise. The choice of tasks to be undertaken is often dictated by immediate needs of the enterprise. For example: the team of systems designers and programmers assigned to employment and payroll of PZL-MIELEC was for almost a year working on "flurry" of changes in the salary system which occurred around 1980/1981 turn of the year. Similar things occurred with assignment of ration cards for state-controlled goods. There has practically not been a single month where the base for assigning them has not changed.

The state of affairs thus presented has an impact on the organization of work of a computer center and also on data processing technologies and programming techniques employed.

The deep economic crisis which has engulfed our country has not spared the computer science field. It is felt most painfully in the area of supply of new computer hardware, spare parts and basic operating supplies: punch cards and paper for printers. ELWRO center does not accept for repairs equipment which--according to existing regulations--it should repair. Only 25 percent of orders for punch cards and printing paper have been accepted. Very poor supply of spare parts and operating materials greatly lowers the morale of computer personnel employed by computer centers.

Right now work still goes on using materials and spare parts in stock. One lives on hope that there will soon come a radical change.

I have the impression that not everyone realizes the consequences which coming to a complete halt in digital computers would entail. Just as it was in the case when the computer system was being introduced, the enterprise would have to be prepared to change back from the automated to the manual processing of data. In order, for instance, to replace the work of computers at PZL-MIELEC it would be necessary to employ some 900 people.

Due to the present situation work assignments have been redirected. Practically speaking, all development of new applications has been stopped in favor of improving the effectiveness of used hardware and improving the quality of software. This period of--I hope--temporary stagnation in the development of new computer applications for management purposes should be used for improving qualifications of computer specialists. For the greatest loss for the enterprise would be the loss of qualified personnel.

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DEVELOPMENT OF FIBER-OPTICS COMMUNICATIONS OUTLINED

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[Article by Wladyslaw Cetner, Julian Kowar, and Andrzej Zielinski, Communications Institute, Warsaw: "Works Carried Out in the Communications Institute in the Field of Fiber-Optics Telecommunications"]

[Excerpt] The first work dealing with the use of coherent optic radiation for the needs of telecommunications was undertaken in the Communications Institute already in 1968. The work then concerned open (working in open space--atmosphere) optic lines using modulated laser light.

In the 1970's the CI [Communications Institute], together with the Military Technical Academy (IEK-WAT), participated in the program of research carried out jointly with the Central Institute for Scientific Research in Communications (CNIIS) in Moscow. This program included the building and testing of an open [optical] line operating on a wavelength of 10.6 micron meters, using CO_2 laser.

In the CI, intensive research in feber-optics technology was undertaking beginning in October 1979, when the Independent Fiber-Optics Telecommunications Laboratory was created.

Scope of Research in Fiber-Optics Technology in the Communications Institute

The world development of fiber-optics technology and the development of multimode fiber-optics at the Marie Curie-Sklodowska University in Lublin caused a rather wide range of research and design work to be undertaken in the country in the field of fiber-optics telecommunications. This work was organized in the framework of key problem 06.2 titled: "The Development of Telecommunications--the Systems and Equipment," for which the Communications Institute was in 1975-1980, and still is, the first-stage coordinator. Unfortunately, the current symptoms of the economic crisis, and above all the curbing of the import of elements which are not produced in this country, have necessitated a considerable cut in the size of research and a critical selection of the most urgent and at the same time realizable [research] questions.

The main emphasis was put on proper future development of telecommunications fiber-optics in this country, based chiefly on solidly build foundations in

the fields of metrology, technology of fiber-optics and cables, optic-electronic elements, and fiber-optics elements and systems. The development of active elements--luminescent diodes, semiconductor lasers and photo-sensors transcends the established frames of the CI's research activity. The development of those elements was entrusted to the Electronics Institute of CEMI and the Division of Experimental Physics of the Marie Curie-Sklodowska University. The development of production methods and the experimental production of fiber-optics were undertaken in the Division of Physical Chemistry of the Marie Curie-Sklodowska University, while the experimental production of fiber optics cables is presently carried out as part of the work of the DOPiT [District Post and Telecommunications Directorate] in Lublin.

The Communications Institute has undertaken the development of passive elements, components of the fiber-optics systems. These are solid and separable (plug-in) junctions of the segments of fiber-optics, directional (hybrid) couplers, and change-over switches, as well as other elements. The junctions are an indispensable part of fiber-optics systems and of appropriate measuring systems and equipment.

Unlike that of the connecting junctions, the production of solid, welded, glued and separable fiber-optics junctions presents a serious technical problem. This is due to the limiting of optic power losses in the junctions. These losses grow strong when the inaccuracy of connections is of the order of a few micrometers in the joinings of multimode fiber-optics, and below one micrometer in the joinings of one-mode fiber-optics. Solid junctions must also be made outd-ors at the installation of the fiber-optics cable.

The directional interconnections (socket outlets) and fiber-optics switches are technologically difficult elements in the process of their production and therefore expensive to import. They are indispensable in fiber-optics subscriber networks, in cable television and in aerial systems of collective reception realized by fiber-optics technology, as well as in more complex measuring stations.

The Communications Institute's undertaking of these themes arose from the rise in import prices for fiber-optics elements and the demand for them by the Institute and the domestic market.

The Institute also includes in its research work in the fields of measuring the basic parameters of transmission cables and fiber-optics, such as: attenuation, dispersion, the profile of the refraction index, and geometrical parameters of fiber-optics cables. The latter concern the core diameter and fiber-optics lining, and the size of their deviation from the circularity, concentricity and misalignment. These parameters should be compatible with the recommendations of the CCITT.

In the sphere of this basic research, indispensable for fiber-optics telecommunications, the Communications Institute has already obtained concrete results, which will be more extensively described in the later part of the article.

Testing of Junctions

In the Communications Institute a small series of separable junctions has already been produced. On the previously described measuring station a measurement of attenuation of these junctions has been made.

The testing included about 200 solid junctions: the joinings were made of segments of the same fiber-optics, and segments of fiber-optics selected at random, in geometrical and optical parameters (refracting index, numerical aperture). The results show that junctions welded by the method elaborated at the CI, made of like segments of fiber-optics usually had losses below 0.1 dB, which corresponds to good junctions made by Western firms. In the case of junctions made of fiber-optics segments differing much in parameters, the losses were between 0.4 and 2.0 dB.

It ought to be emphasized that the CI has already received several orders for the described device (type FS01) from domestic and East German customers.

The welded junctions are characterized by the smallest losses and are commonly used in fiber-optics communications systems. The places of welding result from the length of the segments of the manufactured cables used for installation outdoors. The welding place must be appropriately secured from cracks and external damage, because [the welding] is done on the fiber-optics itself, without its protective layer.

Other Fiber-Optics Tests

The measurement of the profile of refracting index along the diameters of the lateral section of the fiber-optics is very important because of the minimalization of mode dispersion in multimode fiber-optics, which limits the width of the frequency band of the transmitted information, or causes harmful expansion (or rather a flattening) of transmitted pulses in digital systems. As already mentioned, the measurement of the profile allows to define the geometrical parameters of the fiber-optics.

The dispersion is measured in the fields of frequency and time. In the latter case, the enlarging of the pulses transmitted as the optical wave propagates along the fiber-optics, is measured. For understandable reasons, the narrowing of the transmitted frequency band and enlarging of the pulses limits the informational traffic capacity of both analogous and digital fiber-optics systems.

In the Communications Institute appropriate methods of measuring these two quantities were developed.

Fiber-Optics Systems

Mastering the methods of precise measurements of attenuation and dispersion values of fiber-optics, and—in the case of multimode gradient fiber-optics— the profiles of changes of the refracting index, production of a certain number of separable junctions and mastering the technology of welded junctions,

constituted the basis for realizing the main task of the Communications Institute, that is, developing the appropriate transmission instruments and installing and testing fiber-optics telecommunications systems.

In technologically advanced countries, many experimental and operating fiber-optics systems are already functioning. They can be found in all the elements of the telecommunications networks; in local and long distance telephone networks, and in subscriber networks with integrated audio-video data transmission services.

In Poland a wide implementation of fiber-optics systems is also foreseen. For this reason during the current 5-year plan the CI intends to install on its premises an experimental fiber-optics system that would allow for local testing of both its own subassemblies, instruments and systems, and ones supplied for this purpose. The length of the cable route need not be too great, because by joining in a series of the fiber-optics which are part of one or several cables virtually any size system can be obtained.

A very important problem is to develop in the shortest possible time domestic optic-electric elements with parameters and reliability that would allow their application in telecommunications fiber-optics systems.

From the moment of the creation of the telecommunications fiber-optics laboratory in the CI, work on miniaturized transmitting and receiving assemblies intended for use in fiber-optics telephonic digital systems and in systems to be used in the transmission of television signals has been going on.

Currently a transmitter and receiver that go toward the making of a universal digital system with the multiplication factor of 30 and 120 telephone channels are in the final stage of development. The measuring station for the testing of this system together with its instruments is shown on illustration 15 [not shown]. These instruments are basically intended for installation in an experimental fiber-optics system located on the CI's premises. The digital systems developed in the CI are also to be installed in Lodz, where an experimental system connecting two telephone exchanges is to be started. After the final termination of the experimental testing of the fiber-optics systems, the results obtained will be presented separately.

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